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Airborne imaging for heritage documentation using the Fotokite tethered flying camera

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Since the beginning of aerial photography, researchers used all kinds of devices (from pigeons, kites, poles, and balloons to rockets) to take still cameras aloft and remotely gather aerial imagery. To date, many of these unmanned devices are still used for what has been referred to as Low-Altitude Aerial Photography or LAAP. In addition to these more traditional camera platforms, radio-controlled (multi-)copter platforms have recently added a new aspect to LAAP. Although model airplanes have been around for several decades, the decreasing cost, increasing functionality and stability of ready-to-fly multi-copter systems has proliferated their use among non-hobbyists. As such, they became a very popular tool for aerial imaging. The overwhelming amount of currently available brands and types (heli-, dual-, tri-, quad-, hexa-, octo-, dodeca-, deca-hexa and deca-octocopters), together with the wide variety of navigation options (e.g. altitude and position hold, waypoint flight) and camera mounts indicate that these platforms are here to stay for some time. Given the multitude of still camera types and the image quality they are currently capable of, endless combinations of low- and high-cost LAAP solutions are available. In addition, LAAP allows for the exploitation of new imaging techniques, as it is often only a matter of lifting the appropriate device (e.g. video cameras, thermal frame imagers, hyperspectral line sensors).

Archaeologists were among the first to adopt this technology, as it provided them with a means to easily acquire essential data from a unique point of view, whether for simple illustration purposes of standing historic structures or to compute three-dimensional (3D) models and orthophotographs from excavation areas. However, even very cheap multi-copters models require certain skills to pilot them safely. Additionally, malfunction or overconfidence might lift these devices to altitudes where they can interfere with manned aircrafts. As such, the safe operation of these devices is still an issue, certainly when flying on locations which can be crowded (such as students on excavations or tourists walking around historic places).

As the future of UAS regulation remains unclear, this talk presents an alternative approach to aerial imaging: the Fotokite. Developed at the ETH Zürich, the Fotokite is a tethered flying camera that is essentially a multi-copter connected to the ground with a taut tether to achieve controlled flight. Crucially, it relies solely on onboard IMU (Inertial Measurement Unit) measurements to fly, launches in seconds, and is classified as not a UAS (Unmanned Aerial System), e.g. in the latest FAA (Federal Aviation Administration) UAS proposal. As a result it may be used for imaging cultural heritage in a variety of environments and settings with minimal training by non-experienced pilots. Furthermore, it is subject to less extensive certification, regulation and import/export restrictions, making it a viable solution for use at a greater range of sites than traditional methods. Unlike a balloon or a kite it is not subject to particular weather conditions and, thanks to active stabilization, is capable of a variety of intelligent flight modes. Finally, it is compact and lightweight, making it easy to transport and deploy, and its lack of reliance on GNSS (Global Navigation Satellite System) makes it possible to use in urban, overbuilt areas.

After outlining its operating principles, the talk will present some archaeological case studies in which the Fotokite was used, hereby assessing its capabilities compared to the conventional UAS's on the market.